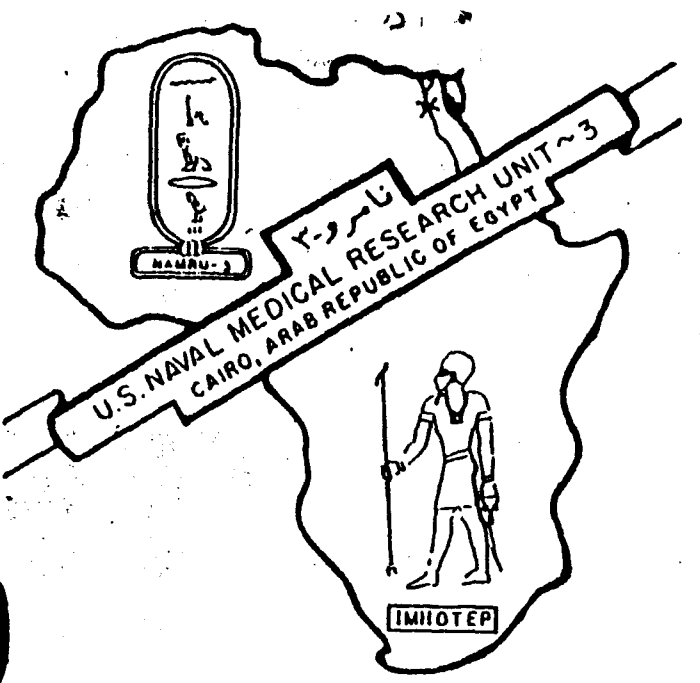

(2)

PUBLICATION REPORT

1562

44/89-90

EPIDEMIOLOGY OF HEPATITIS B IN THE GEZIRA REGION OF SUDAN

BY

Kenneth C. Hyams, Mohamed A. Al-Arabi, Ahmed A. Al-Tagani, James F. Messiter, Abdella A. Al-Gaali, and John F. George

U.S. NAVAL MEDICAL RESEARCH UNIT NO. 3
(CAIRO, ARAB REPUBLIC OF EGYPT)
FPO NEW YORK 09527

Am. J. Trop. Med. Hyg., 40(2), 1989, pp. 200–206 (8-176)

EPIDEMIOLOGY OF HEPATITIS B IN THE GEZIRA REGION OF SUDAN

KENNETH C. HYAMS, MOHAMED A. AL-ARABI, AHMED A. AL-TAGANI, JAMES F. MESSITER, ABDELLA A. AL-GAALI, AND JOHN F. GEORGE

U.S. Naval Medical Research Unit No. 3, Cairo, Egypt, Omdurman Municipal Hospital, Central Public Health Laboratory, Khartoum, Sudan, and American Embassy, Khartoum, Sudan

Abstract. To determine the prevalence of and risk factors for hepatitis B infection in rural Sudan, 2 villages in the Gezira were surveyed. There were 851 subjects (age 1–89 years; mean age 24.6 years) of equal sex distribution, 408 from Khalawaat and 443 from Saleim. HBsAg was found in 18.7%, and seropositivity for any hepatitis marker (HBsAg, anti-HBs, or anti-HBc) was found in 63.9%. The prevalence of HBsAg was highest in subjects <5 years of age (32.3%). Seropositivity for any hepatitis marker increased from 48.4% in subjects <5 years to 88.5% in persons ≥50 years of age. HBeAg was present in 70% of HBsAg-positive women of childbearing age. Residence in Khalawaat and parenteral therapy for malaria were found to be independent risk factors for HBsAg-positivity. Age, residence in Khalawaat, crowding, and having had a tattoo were predictive of seropositivity for any hepatitis marker. The reason for increased markers of hepatitis B in Khalawaat compared to Saleim was not apparent.

Of adults in Africa, >50% may have serologic evidence of past hepatitis B infection.[1,2] The predominant modes of transmission of hepatitis B in Africa are not known. Infection occurs at an early age, but maternal-infant transmission does not appear to be as important as in Southeast Asia.[3–5]

The prevalence of hepatitis B infection in Sudan is also high. Hepatitis B antigenemia is found in 19% of some groups. Again, the major modes of transmission are not known.[6–8] The present study determined the prevalence and risk factors of hepatitis B infection in 2 villages in the Gezira.

MATERIALS AND METHODS

Patient population

Study subjects were from the villages Khalawaat and Saleim, which are approximately 60 km apart. The Gezira region is between the White and Blue Nile south of Khartoum in the northern, arid, and predominantly Moslem region of Sudan. It is the principle agricultural area of this country. An extensive system of man-made canals provides irrigation for farming. A network of unpaved roads connects villages which are engaged mainly in agricultural activities.

These 2 villages were selected because their differing sizes and health systems offered contrasts which could help determine modes of hepatitis B transmission. Khalawaat has approximately 1,000 inhabitants. A 1 room "dressing station" staffed by a nurse with no technical training is the only source of local health care. The station contains few drugs and no diagnostic equipment.

Saleim has approximately 3,000 inhabitants. Health care is provided in a dispensary staffed by a technician with 2 years of training in the diagnosis and treatment of common infections. A microscope is present for the identification of malaria and stool parasites. Antimalarial and antischistosomal drugs are available but in short supply.

Living conditions in the 2 villages are similar. Houses are constructed of mud brick, and animals are kept within family compounds adjacent to dwellings Electricity is supplied intermittently to a few buildings by gasoline generators.

Water is provided in both villages by wells. Some residents obtain water directly from the wells manually; others have access to water piped to various areas from a central elevated holding tank. Outdoor dry pits are used for sewage disposal in nearly all homes.

The populations are stable, although adult men will often have worked for brief periods in other

areas of the Sudan. It is unlikely that any study subjects ever visited the other village.

Field survey

Each village was surveyed on 3 consecutive days during December 1986. The project was explained to the village elder, and his consent was obtained. All villagers appearing at the study site were evaluated after individual informed consent was obtained. It was not possible to evaluate subjects grouped by household. Subjects were included on the basis of time of appearance. Selection bias cannot be discounted.

Three Sudanese physicians initially interviewed participants and completed a questionnaire. Basic demographic data, including age, sex, occupation, home water source, family size, and the number of rooms in the home, were elicited. A crowding index was calculated for each person in the study by dividing the number of household members by the number of rooms in the home. Study subjects were asked about potential risk factors for hepatitis B transmission, including blood transfusions, hospitalizations, childbirth, dental work, tattoos, and the number and types of treatment for schistosomiasis and malaria. A history of jaundice or contact with jaundiced household members and friends was also noted. Subjects were examined only for jaundice.

Seven ml or less of blood was drawn from each subject. Samples were kept cool with icepacks until centrifuged. Serum samples were then frozen at −20°C. Each subject was provided with containers for stool and urine samples. All subjects found positive for schistosomiasis were treated with praziquantel.

Laboratory

Sera were tested for HBsAg, anti-HBs, anti-HBc, anti-delta (anti-HD), and e antigen (HBeAg) using enzyme-immunoassay test kits (Abbott Laboratories, North Chicago, IL). Samples were first tested for HBsAg. If positive for HBsAg, samples were further tested for anti-HD and HBeAg. If negative for HBsAg, samples were tested for anti-HBs and subsequently for anti-HBc if negative for anti-HBs.

Stools were examined for *Schistosoma mansoni* eggs using a modified Kato method.[9] Urine was examined for *S. haematobium*.[10]

Statistics

Univariate comparisons were performed using the chi-square test with Yates' correction for proportions and the Student's *t*-test for continuous variables. To identify independent associations, stepwise (forward and backward) unconditional multiple logistic regression analysis was performed using the True Epistat software package (Epistat Services, Richardson, TX). For data analysis of hepatitis markers, subjects were categorized as antigen-positive (subjects positive for HBsAg, seropositive (subjects positive for any of 3 markers: HBsAg, anti-HBs, or anti-HBc), or seronegative (subjects negative for all hepatitis markers). Mean values were reported as ±1 SD. Significance was designated at $P < 0.05$.

RESULTS

Patient population

There were 851 subjects. The mean age was 24.6 ± 17 years. Fifty-one percent were male (mean age 25.3 ± 18.7 years) and 49% were female (mean age 23.8 ± 15.1 years). Approximately 50% of the inhabitants of Khalawaat (408 individuals, age 1–89 years, mean age 23.4 ± 17.1 years) were sampled. Approximately 15% of the inhabitants of Saleim (443 individuals, age 1–81 years, mean age 25.7 ± 16.9 years) were sampled. The male-to-female ratios were similar.

The socioeconomic standards of the 2 communities were comparable. Subjects lived in mud-brick houses with an average of 7.8 people in 2.8 rooms in Khalawaat (crowding index 3.2 ± 1.7) and 7.9 people in 3 rooms in Saleim (crowding index 3.0 ± 1.7). Goats, chickens, and donkeys were kept by a similar percentage of families from each village.

Subjects were generally healthy and none were jaundiced. There was no evidence of protein-calorie malnutrition.

Prevalence of hepatitis markers

Hepatitis B surface antigen was found in 159 subjects (18.7%). Additionally, anti-HBs was found in 247 and anti-HBc in 138. When all markers were considered, 544 (63.9%) subjects were seropositive. In Khalawaat, 22.3% were HBsAg positive and in Saleim, 15.3% were pos-

TABLE 1

Hepatitis markers in Khalawaat and Saleim

Marker	Percent positive	
	Khalawaat	Saleim
HBsAg*	22.3 (91/408)	15.3 (68/443)
Anti-HBs	34.4 (109/317)	36.8 (138/375)
Anti-HBc	34.1 (71/208)	28.3 (67/237)
HBsAg, anti-HBs, or anti-HBc†	66.4 (271/408)	61.6 (273/443)
Anti-delta	26.3 (15/57)	29.3 (17/58)
HBeAg‡	58.7 (37/63)	74.4 (32/43)

* $P = 0.012$.
† $P = 0.17$.
‡ $P = 0.15$.

itive ($P = 0.012$). Seropositivity for any hepatitis marker was found in 66.4% of subjects living in Khalawaat and 61.6% in Saleim ($P = 0.17$; Table 1).

The prevalence of HBsAg-positivity was highest (32.3%) in subjects <5 years, but then remained fairly constant as age increased. In contrast, seropositivity for any hepatitis marker was related to advancing age, increasing from 48.4% in subjects <5 years to 88.5% in those ≥50 years (Fig. 1). The most marked increase in seropositivity was observed in study subjects 20–29 years old. No children <1 year were tested.

Age-specific analysis of hepatitis B markers demonstrated a higher HBsAg and seropositivity rate in Khalawaat than in Saleim for most age groups (Table 2).

A higher percentage of men than women were positive for HBsAg (19.4% vs. 17.9%) and a higher percentage of men were seropositive for any hepatitis marker (66.0% vs. 61.7%). However, these differences were not statistically significant.

Age-specific analysis demonstrated similar rates of infection for both men and women. There was no association in either village between the frequency of hepatitis markers and a person's primary occupation or home water source.

Of 115 HBsAg-positive samples tested for delta antibody, 27.8% were positive. No significant difference in prevalence of anti-HD between the 2 villages was observed (Table 1). The mean age of anti-HD positive and negative subjects was similar (25.5 vs. 24.1 years).

In 106 HBsAg-positive sera, HBeAg-positivity was comparable in Saleim (74.4%, 32/43) and Khalawaat (58.7%, 37/63; $P = 0.15$). In women 16–45 years old who were tested, the percentage positive for HBeAg was 76.5% (13/17) in Saleim and 61.5% (8/13) in Khalawaat ($P = 0.63$).

Schistosomiasis infection

Of 822 stool samples and 794 urine samples, 380 (46.2%) were positive for *S. mansoni* and 12 (1.5%) for *S. haematobium*. The mean egg count for *S. mansoni* infected persons was 615 ± 1,041 eggs/gram, and *S. haematobium* subjects averaged 21 ± 23 eggs/10 ml urine.

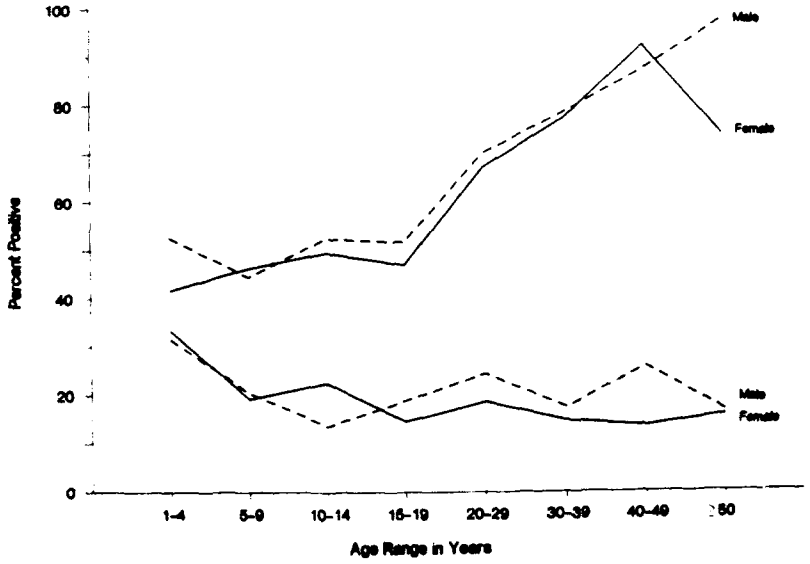

FIGURE 1. Comparison of the age-specific prevalence rates of HBsAg (lower 2 curves) and seropositivity (upper 2 curves) between females (——) and males (- - - - -).

TABLE 2

Comparison of age-specific prevalence of HBsAg and seropositivity for HBsAg, anti-HBs, or anti-HBc in Khalawaat and Saleim

Age (years)	Percent HBsAg positive		Percent seropositive	
	Khalawaat	Saleim	Khalawaat	Saleim
1–4	41.2 (7/17)	21.4 (3/14)	64.7 (11/17)	28.6 (4/14)
5–9	24.6 (15/61)	13.3 (6/45)	47.5 (29/61)	42.2 (19/45)
10–14	21.3 (20/94)	11.5 (7/61)	55.3 (52/94)	44.3 (27/61)
15–19	21.7 (10/46)	13.8 (11/80)	56.5 (26/46)	45.0 (36/80)
20–29	21.1 (15/71)	20.8 (20/96)	74.6 (53/71)	63.5 (61/96)
30–39	16.7 (7/42)	15.4 (8/52)	83.3 (35/42)	73.1 (38/52)
40–49	18.5 (5/27)	19.5 (8/41)	88.9 (24/27)	90.2 (37/41)
≥50	24.0 (12/50)	9.3 (5/54)	82.0 (41/50)	94.4 (51/54)
Totals	22.3 (91/408)	15.4 (68/443)	66.4 (271/408)	61.6 (273/443)

Twenty-eight percent of the subjects from Khalawaat and 72.2% from Saleim had been treated for schistosomiasis, and 86% from Khalawaat and 79.5% from Saleim had been treated for malaria. Treatment using parenteral medications was very common. Injections had been received by 14.8% of the subjects for schistosomiasis infection and by 69.5% for the treatment of malaria. Only 8 (2.5%) individuals ≤15 years had received parenteral antischistosomal therapy. There was no difference between the 2 villages in the number of injections received by study subjects.

Risk factors

Univariate analysis suggested an association between the presence of HBsAg and 2 risk factors: residence in Khalawaat and infection with *S. mansoni*. When seropositivity for all hepatitis markers was analyzed, associations were noted for crowding, hospitalization, dental treatment, tattoos, jaundice, infection with *S. mansoni*, and parenteral therapy (Table 3).

Because the prevalence of hepatitis markers and the occurrence of many potential risk factors of infection were associated with age, multiple stepwise logistic regression analysis was used to identify independent associations. Residence in Khalawaat and parenteral therapy for malaria were found to be significantly associated with HBsAg-positivity. Age, residence in Khalawaat, crowding, and a tattoo were found to be independently predictive of seropositivity for any hepatitis marker (Table 4).

There was no association between positivity for delta antibody and any potential risk factors. Delta-positive study subjects did not report a history of clinical jaundice more frequently than others.

DISCUSSION

The high prevalence of HBsAg in this study is comparable to that of the most highly endemic areas of hepatitis B infection in Southeast Asia, Ethiopia, and Somalia.[1,11–15] Half of this study population had been infected by 4 years of age, and most of the population had markers of hepatitis B infection by the age of 40.

Most of the subjects positive for HBsAg can be assumed to be chronic antigen carriers since none were acutely ill or jaundiced, and HBsAg detected in cross-sectional surveys generally indicates chronic infection.[16–17] The risk of acquiring chronic hepatitis B appeared to be greatest in the young. A similar pattern of early childhood infection is found in Southeast Asia, where a large percentage of chronic carriers results from perinatal transmission.[18] Perinatal transmission could also account for substantial infection and resulting chronic antigenemia in this Sudanese population. The high proportion of women of child-bearing age who were e antigen positive lends support to this prospect.[19] Alternatively, early horizontal transmission within families could account for this pattern of infection as in other parts of Africa.[3,5]

A high prevalence (28%) of delta infection among HBsAg-positive study subjects was found. Delta infection has been found to be a cause of acute hepatitis in nearby Khartoum and other adjacent countries.[8,20] Association between a history of jaundice and delta infection was not detected. The reason is not apparent from the data.

TABLE 3

Univariate analysis of HBsAg and seropositivity for any hepatitis marker in all study subjects

Variable	Percent HBsAg positive			Percent seropositive		
	Variable present	Variable absent	*P* value	Variable present	Variable absent	*P* value
Khalawaat resident	22.3 (91/408)	15.3 (68/443)	0.012	66.4 (271/408)	61.6 (273/443)	0.166
Male sex	19.4 (85/438)	17.9 (74/413)	0.639	66.0 (289/438)	61.7 (255/413)	0.224
Crowding index*	19.6 (82/418)	17.8 (77/432)	0.56	67.5 (282/418)	60.7 (262/432)	0.046
History of:						
Hospitalization	19.7 (55/279)	18.2 (104/572)	0.657	70.6 (197/279)	60.7 (347/572)	0.006
Dental treatment	19.5 (33/169)	18.5 (126/682)	0.839	76.3 (129/169)	60.9 (415/682)	<0.001
Transfusion	16.2 (6/37)	18.8 (153/814)	0.859	70.3 (26/37)	63.6 (518/814)	0.518
Tattoo	22.3 (40/179)	17.7 (119/672)	0.191	78.2 (140/179)	60.1 (404/672)	<0.001
Jaundice	18.7 (34/182)	18.6 (124/668)	1.000	70.3 (128/182)	62.1 (415/668)	0.051
Contact with jaundiced person	20.2 (107/531)	16.3 (52/319)	0.193	64.8 (344/531)	62.7 (200/319)	0.589
Infection with:						
S. mansoni	22.4 (85/380)	16.5 (73/442)	0.042	67.4 (256/380)	60.6 (268/442)	0.054
S. haematobium	16.7 (2/12)	19.7 (154/782)	1.000	83.3 (10/12)	63.8 (499/782)	0.273
Parenteral therapy for malaria	17.3 (102/591)	21.9 (57/260)	0.13	66.8 (395/591)	57.3 (149/260)	0.01
for Schistosomiasis	20.6 (26/126)	18.3 (133/725)	0.628	79.4 (100/126)	61.2 (444/725)	<0.001

* Considered present if ≥ median crowding index of 2.75.

TABLE 4

Significant independent predictors of HBsAg and seropositivity by stepwise multivariate logistic regress on analysis

Variable	B-coefficient	*P* value	Odds ratio	95% confidence interval
Antigen positivity (HBsAg)				
Residence in Khalawaat	0.49	0.009	1.64	1.15 to 2.33
Injections for malaria*	0.03	0.022	1.03	1.00 to 1.06
Seropositivity				
Age (per year)	0.05	<0.001	1.05	1.04 to 1.07
Residence in Khalawaat	0.33	0.032	1.39	1.03 to 1.88
Crowding (2 groups)†	0.40	0.007	1.49	1.10 to 2.02
Tattoo (2 groups)	0.46	0.028	1.58	1.04 to 2.39

* Odds ratio based on each additional injection for malaria.
† Continuous variable "crowding" divided at the median.

For many subjects, anti-HBc was the only indication of prior infection. The reason for the variance between anti-HBs and anti-HBc positivity was not apparent. Finding anti-HBc as a single marker was not related to the age or sex of study subjects. Other studies have found a large percentage of individuals positive for anti-HBc but *negative for anti-HBs.*[2, 21, 22]

Several risk factors for hepatitis B transmission, including medical injections, tattooing, and crowded living conditions, were found to be independently associated with hepatitis markers by multivariate analysis. These risk factors have been previously identified as potentially significant in developing countries.[23, 24] The possible spread of hepatitis B by medical injections has been noted before.[8] The relationship between the crowding index and seropositivity could indicate increased hepatitis B transmission due to crowding, or it could indicate other risk factors associated with a lower standard of living.[25]

The reason for the increased risk of hepatitis B infection in Khalawaat could not be determined. No specific difference in lifestyle, standard of living, or health care was found.

Schistosomiasis infection was not found to be a risk factor for hepatitis B. Similar results have been seen in Egypt.[26]

A very high level of hepatitis B infection was found in these 2 villages. Although the exact mechanisms of transmission could not be determined, the initially high level of infection in the youngest study subjects indicates that significant transmission occurs early in life, followed by a steady continuation of exposure in adults of both sexes.

Informed consent was obtained from all study subjects or their parents. Guidelines of the NAMRU-3 Committee for the Protection of Human Subjects were followed.

Grant support: Naval Medical Research and Development Command, NMC, NCR, Bethesda, MD, Work Unit MR00001001-3080.

Authors' addresses: Kenneth C. Hyams, U.S. Naval Medical Research Unit No. 3, Cairo, Egypt. Mohamed A. Al-Arabi and Abdella A. Al-Gaali, Gastroenterology Department, Omdurman Municipal Hospital. Ahmed A. Al-Tagani and John F. George, Central Public Health Laboratory, Khartoum, Sudan. James F. Messiter, American Embassy, Khartoum, Sudan.

REFERENCES

1. Sobeslavsky O, 1980. Prevalence of markers of hepatitis B virus infection in various countries: a WHO collaborative study. *Bull WHO 58:* 621–628. UI:81064988
2. Barin F, Perrin J, Chotard J, Denis F, N'Doye R, Mar ID, Chiron JP, Coursaget P, Goudeau A, Maupas P, 1981. Cross-sectional and longitudinal epidemiology of hepatitis B in Senegal. *Prog Med Virol 27:* 148–162. UI:81200236
3. Whittle HC, Bradley AK, McLauchlan K, Ajdukiewicz AB, Howard CR, Zuckerman AJ, McGregor IA, 1983. Hepatitis B virus infection in two Gambian villages. *Lancet 1:* 1203–1206. UI:83217797
4. Botha JF, Ritchie MJ, Dusheiko GM, Mouton HW, Kew MC, 1984. Hepatitis B virus carrier state in black children in Ovamboland: role of perinatal and horizontal infection. *Lancet 1:* 1210–1212. UI:84218225
5. Marinier E, Barrois V, Larouze B, London WT, Cofer A, Diakhate L, Blumberg BS, 1985. Lack of perinatal transmission of hepatitis B virus infection in Senegal, West Africa. *J Pediatr 106:* 843–849. UI:85210348
6. Omer AH, McLaren ML, Johnson BK, Chanas AC, Brumpt CI, Gardner P, Draper CC, 1981. A seroepidemiological survey in the Gezira, Sudan, with special reference to arboviruses. *J Trop Med Hyg 84:* 63–66. UI:81170660

7. Higashi GI, Bucci TJ, Saleh AS, Banda AR, 1981. Hepatitis B virus surface antigen and antibody in a selected adult population in the Sudan. *Trans R Soc Trop Med Hyg 75:* 476. UI: 82108675
8. Al-Arabi MA, Hyams KC, Mahgoub M, Al-Hag AA, el-Ghorab N, 1987. Non-A, non-B hepatitis in Omdurman, Sudan. *J Med Virol 21:* 217–222. UI:87168340
9. Peters PA, El Alamy M, Warren KS, Mahmoud AA, 1980. Quick Kato smear for field quantification of Schistosoma mansoni eggs. *Am J Trop Med Hyg 29:* 217–219. UI:80172971
10. Scott JA, 1957. Egg counts as estimates of intensity of infection with Schistosoma haematobium. *Texas Rep Biol Med 15:* 425–430.
11. Beasley RP, Hwang LY, Lin CC, Leu ML, Stevens CE, Szmuness W, Chen KP, 1982. Incidence of hepatitis B virus infections in preschool children in Taiwan. *J Infect Dis 146:* 198–204. UI: 82267278
12. Beasley RP, Hwang LY, Lin CC, Chien CS, 1981. Hepatocellular carcinoma and hepatitis B virus. A prospective study of 22,707 men in Taiwan. *Lancet 2:* 1129–1133. UI:82079574
13. Tsega E, Mengesha B, Hansson BG, Lindberg J, Nordenfelt E, 1986. Hepatitis A, B, and delta infection in Ethiopia: a serologic survey with demographic data. *Am J Epidemiol 123:* 344–351. UI:86127257
14. Gebreselassie L, 1983. Prevalence of specific markers of viral hepatitis A and B among an Ethiopian population. *Bull WHO 61:* 991–996. UI:84180907
15. Nuti M, Harare O, Thamer G, 1979. The surface antigen (HBsAg) and the e-antigen (HBeAg) in Somalian patients with acute viral hepatitis. *Trans R Soc Trop Med Hyg 73:* 185–187. UI: 79250118
16. Hawkes RA, Boughton CR, Ferguson V, Vale TG, 1981. The seroepidemiology of hepatitis in Papua New Guinea. II. A long-term study of hepatitis B. *Am J Epidemiol 114:* 563–573. UI: 82065481
17. Szmuness W, Prince AM, Diebolt G, Leblanc L, Baylet R, Masseyeff R, Linhard J, 1973. The epidemiology of hepatitis B infections in Africa: results of a pilot survey in the Republic of Senegal. *Am J Epidemiol 98:* 104–110. UI: 73236048
18. Stevens CE, Beasley RP, Tsui J, Lee WC, 1975. Vertical transmission of hepatitis B antigen in Taiwan. *N Engl J Med 292:* 771–774. UI: 75100250
19. Beasley RP, Trepo C, Stevens CE, Szmuness W, 1977. The e antigen and vertical transmission of hepatitis B surface antigen. *Am J Epidemiol 105:* 94–98. UI:77109061
20. Toukan AU, Abu-el-Rub OA, Abu-Laban SA, Tarawneh MS, Kamal MF, Hadler SC, Krawczynski K, Margolis HS, Maynard JE, 1987. The epidemiology and clinical outcome of hepatitis D virus (delta) infection in Jordan. *Hepatology 7:* 1340–1345. UI:88056776
21. Sherif MM, Abou-Aita BA, Abou-Elew MH, el-Kafrawi AO, 1985. Hepatitis B virus infection in upper and lower Egypt. *J Med Virol 15:* 129–135. UI:85133564
22. Ben-Porath E, Hornstein L, Zeidis J, Nahmias J, Gruia M, Bilgoray B, Satinger Y, 1986. Hepatitis B virus infection and liver disease in Ethiopian immigrants to Israel. *Hepatology 6:* 662–666. UI:86276381
23. Francis DP, 1983. Selective primary health care: strategies for control of disease in the developing world. III. Hepatitis B virus and its related diseases. *Rev Infect Dis 5:* 322–329. UI:83196706
24. Barrett DH, Burks JM, McMahon B, Elliott S, Berquist KR, Bender TR, Maynard JE, 1977. Epidemiology of hepatitis B in two Alaska communities. *Am J Epidemiol 105:* 118–122. UI: 77109053
25. Cherubin CE, Purcell RH, Lander JJ, McGinn TG, Cone LA, 1972. Acquisition of antibody to hepatitis B antigen in three socioeconomically different medical populations. *Lancet 2:* 149–151. UI:72216503
26. Hyams KC, el Alamy MA, Pazzaglia G, el Ghorab NM, Sidhom O, Habib M, Dunn MA, 1986. Risk of hepatitis B infection among Egyptians infected with Schistosoma mansoni. *Am J Trop Med Hyg 35:* 1035–1039. UI:87023554

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION: UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; Distribution is unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S): 44/89-90	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION: U.S. Naval Medical Research Unit No. 3 / 6b OFFICE SYMBOL (If applicable): NAVMEDRSCHU THREE	7a NAME OF MONITORING ORGANIZATION
6c ADDRESS (City, State, and ZIP Code): PSC 452, Box 5000 FPO, AE 09835-0007	7b ADDRESS (City, State, and ZIP Code)
8a NAME OF FUNDING/SPONSORING ORGANIZATION: Naval Medical Research and Development Command / 8b OFFICE SYMBOL (If applicable): NAVMEDRSCH NAVCOM	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (City, State, and ZIP Code): National Naval Medical Center Building 1, Tower 12 Bethesda, MD 20889-5044	10 SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO: 61152N; PROJECT NO: MR00001; TASK NO: 001; WORK UNIT ACCESSION NO:

11 TITLE (Include Security Classification)
Epidemiology of Hepatitis B in the Gezira Region of Sudan. (UNCLASSIFIED).

12 PERSONAL AUTHOR(S) Ayams, K.E.*, al-Arabi, Mohamed A.*, Al-Tagani, Ahmed A.*, Messiter, James F.+, Al-Gaali, Abdella A.* and George, John F.*

13a TYPE OF REPORT	13b TIME COVERED FROM ____ TO ____	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
		1989	7

16 SUPPLEMENTARY NOTATION
Published in: Am. J. Trop. Med. Hyg., 40(2):200-206, 1989; Acc. No. 1562.

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Hepatitis B; Prevalence; Risk factors; Patients; Field survey; Gezira Region, Sudan.

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

To determine the prevalence of and risk factors for hepatitis B infection in rural Sudan, 2 villages in the Gezira were surveyed. There were 851 subjects (age 1-89 years; mean age 24.6 years) of equal sex distribution, 408 from Khalawaat and 443 from Saleim. HBsAg was found in 18.7% and seropositivity for any hepatitis marker (HBsAg, anti-HBs, or anti-HBc) was found in 63.3%. The prevalence of HBsAg was highest in subjects <5 years of age (32.3%). Seropositivity for any hepatitis marker increased from 48.4% in subjects <5 years to 88.5% in persons ≥50 years of age. HBeAg was present in 70% of HBsAg-positive women of childbearing age. Residence in Khalawaat and parenteral therapy for malaria were found to be independent risk factors for HBsAg-positivity. Age, residence in Khalawaat, crowding, and having had a tattoo were predictive of seropositivity for any hepatitis marker. The reason for increased markers of hepatitis B in Khalawaat compared to Saleim was not apparent.

* Omdurman Municipal Hospital, Central Public Health Laboratory, Khartoum, Sudan.
+ American Embassy, Khartoum, Sudan

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	UNCLASSIFIED

22a NAME OF RESPONSIBLE INDIVIDUAL	22b TELEPHONE (Include Area Code)	22c OFFICE SYMBOL
Research Publications Branch	202-284-1381	R.P.B.

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

* U.S. Government Printing Office: 1986—607-044

UNCLASSIFIED